into spherical balls, and when felted they sometimes alternate with layers of phosphates, so that when divided the transverse sections of these are found to be marked by concentric lines.

III. The true Oriental Bezoar is found in the wild goat of Persia (*Capra ægagrus*), and is brought to India from the Persian Gulf. In appearance it is black and hard, oval in shape, with a smooth surface, which has a peculiar shiny lustre.

This stone consists entirely of ellagic acid, which is an insoluble organic acid derived from certain constituents of the diet of the Persian goat. This acid can also be extracted from an infusion of gall-nuts when exposed to the air.

Bezoars were frequently set in hoops of gold or silver, having a chain of some metal by which they were suspended in the liquid to which it was desired they should impart their curative virtues.

Koemfer says: "In Persia all people of consequence possess one or more of these stones preserved with great care as valued treasures." A proof of their value is found in the fact that amongst the treasures sent to the Emperor Napoleon the First, by the Shah of Persia, were three Bezoars valued at nearly two hundred pounds.

Five hundred crowns (£125) have been given for one such stone, and Tavernier mentions one, weighing four ounces, which was sold for one hundred and fifty pounds.

The diseases supposed to be cured by Bezoars were of varied character, such as epilepsy, palpitation, vertigo, contagious fevers, etc. It is said to have been a custom in Persia to take a dose of powdered Bezoar at the beginning of the year to protect the body from poison for the succeeding year.

They may have been useful perhaps in some cases, owing to the amount of bile contained in them, and also because they were sometimes steeped in infusions of active medicinal plants.

IV. The Occidental Bezoar.

This is found in the goat of Peru and India, and, as a rule, it is larger, lighter in color, and for the most part without the peculiar black metallic lustre of the true Oriental stone, and is of much less value. The chamois yields what is known as German Bezoar, and another similar stone is found in the llamas of Peru.

The high price of the Oriental Bezoar led to numerous imitations, for the most part made of chalk and pipe clay, frequently gilded to give the high polish of the Eastern stone.

By putting butter of antimony under the action of nitric acid an artificial Bezoar can be made, and other imitations were made of vegetable resin identical with the litho-fellic acid of M. Goebel, which he found in a calculus examined by him. These stones are sometimes called resino-bezoardic concretions.

The snake stones of the Portuguese were probably made by the Brahmins, who pretended that they were taken from behind the head of the Cobra da Capello. They were called Pedra di Cobra, and were made of calcined bone-earth finely powdered and mixed with musk and aromatic gums. They were probably of use when applied to wounds, although not quite in the way imagined, for, being highly porous and absorbent, when applied in quick succession to a recent snake-bite, these stones would naturally draw out the poison by capillary action; when one stone fell off another would be supplied until the wound was sucked dry. Koemfer says 28 stones were needed to be applied to effect a cure.

Fossil Bezoars are found in Sicily in sand and clay-pits. They are concretions of a purple color, around some usually organic body, and are of the size of a walnut.

V. Concretions of phosphates of magnesia and ammonia. The consideration of these calculi would hardly come within the limits of this paper.

VI. Ambergris.

Concretions found in the Spermaceti whale. This substance is found also floating on the sea upon the coasts of Japan, Coromandel, and Madagascar. It is of very light specific gravity, ash-colored, with black veins and spots. It is supposed to be a product of disease, as it is only found in dead or sickly whales.

One more so-called Bezoar may be mentioned, and then, as far as is known, all the various kinds will have been touched upon.

In the Malay Peninsular there is sometimes found in the cocoanut a stony concretion, properly called *Callapitte*, which is worn by the Malays as an amulet of great value. This is so like Bezoar that it is sometimes mistaken for it, although a purely vegetable product.

THE STUDY OF MOULTING IN BIRDS.

BY WITMER STONE, M.A., CONSERVATOR, ORNITHOLOGICAL SECTION, ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

THE question of change of plumage in birds, even in our commonest species, has never received the attention that it deserves, and, considering the number of ornithologists which we now have in the United States it seems strange that we know so little of the matter.

Perhaps now that the field for the discovery of new species or races of North American birds is narrowing so rapidly, attention will be turned to the study of moulting and other none the less interesting phases of bird life. Comparatively little material seems to have been gathered as yet for the proper discussion of plumage changes, for in almost all the private collections of bird-skins that I have examined I have been struck with the lack of specimens illustrating seasonal changes of plumage, the bulk of the material being either adult spring birds or fall birds which have completed the moult.

The reason for this is easily seen, as in August, the season when most birds experience their complete moult, collecting is by no means easy work. The birds themselves are quiet and inactive, which renders them inconspicuous and hard to find; then, also, the specimens secured during the moulting season are difficult to prepare satisfactorily, while the heat of mid-summer renders immediate preparation necessary. Such obstacles should not, however, stand in the way of the collector and those making local collections of birds should aim to have a sufficient series of each species to show all its seasonal changes of plumage.

Having been recently engaged in examining some interesting series of moulting birds, a few words on these and the question of moults in our passerine birds in general may not be out of place.

Change of plumage in birds, as is well known, takes place in two ways (1) by the acquisition of an entirely new set of feathers and (2) by an abrasion or wearing away of portions of the old feathers.

As a matter of fact both of these methods are employed by all our birds though the amount of change and the number of changes during the year vary in different species.

In all our birds there is a moult of all the feathers late in the summer or early in September, when the breeding season is over, and the feathers are in the poorest condition. The moult at this season is an obvious necessity, as without it the birds would be unable to accomplish their autumnal migration and would be but ill prepared to withstand the cold of winter. Specimens secured just before this moult takes place are in a wretched condition, many of the tail feathers are reduced to mere spines and the wing feathers are often more or less broken while the body plumage is very much worn and some patches are often entirely lacking.

In effecting the complete moult the feathers are renewed a few at a time in a regular sequence, and the utility of this can easily be seen for if the old plumage was all lost at once the bird would be unable to fly for some days and would in all probability perish. On the wings the moult begins with the middle feathers and extends outward and inward, corresponding feathers being lost from each wing simultaneously. At the same time the feathers on the sides of the breast, centre of the back, and the wing coverts are renewed. Male bobolinks taken in this state show the process very clearly, and the bright bands of buff forming an inverted V on the breast stand out in relief against the dull black of the old summer plumage. The change of plumage on the other parts of the body follows rapidly, and the new dress is donned in a remarkably short time, with the exception of the last wing and tail quills.

The second method of changing plumage — by abrasion — is best seen in birds having parti-colored plumage where the centre of the feather is of one hue and the margin of another. Of course, abrasion occurs in all birds, but when the feathers are

uniform in color no marked difference is produced by the process. The abrasion begins soon after the autumal moult and continues throughout the year, being effected by the general wear and tear on the plumage and by the action of the bird itself in cleaning its feathers by drawing them through its bill. The margin of the feather—that is the terminal portion of the barbs—seems to become brittle and break off at a slight touch, the point at which the fracture occurs being on the line where the color changes, in parti-colored feathers. In this way the color of a bird may be entirely changed without the loss or gain of a feather, for owing to the shingled arrangement of the plumage only the terminal portion of the feather is seen, and when this is worn off the central and basal portion, which is frequently differently colored, comes into view.

The series of snow-buntings collected in Greenland by the late Peary expedition, which have passed through my hands, taken in connection with winter specimens from Pennsylvania, show this method of plumage change very well. Taking the feathers of the back, for instance; in the winter birds we find them so broadly tipped with white and brown as to give a light-colored appearance to the bird; in the summer specimens, however, the light tips have been entirely lost and the back becomes solid black. The actual shape of these feathers has changed too, for while those of the winter birds were oval, those of the summer specimens are found to be pointed, with the sides somewhat concave. This was the shape of the black central portion of the feathers in the winter, and when the light margin has been worn off the black portion is, of course, all that remains. This change of shape in the feathers, due to abrasion, is best seen, however, in the curlews and other birds in which the back and rump feathers have peculiarly lobed black centres with light-re-colored margins. The breeding birds of these species will be found to have these feathers deeply sinuated along the margins due to the loss of the light portions, between the black lobes, in striking contrast to the oblong oval feathers of the fall plumage.

In birds which experience a loss of the tips of the feathers by abrasion, but which, owing to the manner of coloration of the feathers do not show any marked change in the general coloration of their plumage, as in the common Song Sparrow, the fall specimens can still be distinguished from spring ones at a glance; as the plumage in the former is long and blended while in the latter the feathers have the appearance of having been clipped with shears.

As has already been said, these two methods of changing plumage (1) by a complete moult, and (2) by abrasion, take place in all birds, but the time and extent of the changes differ in different species.

Our passerine birds may be grouped in three classes according to the changes which take place in their plumage during the year. The most usual system is (1) a complete moult in the autumn or late summer and (2) an abrasion of the tips and margins of the feathers in the spring accompanied by a more or less extensive renewal of the smaller body of feathers.

In some species the acquisition of new feathers in the spring is so slight that it is scarcely apparent and can only be detected by careful scrutiny while in other cases considerable patches of feathers are renewed.

In the Sharp-tailed Finch, of which I have examined a series of eighty specimens taken during every month of the year on the New Jersey salt marshes by Mr. I. N. DeHaven and myself, I find a considerable acquisition of new feathers taking place in April; in some individuals even the tail feathers are being renewed, which is not surprising as owing to the habits of the bird the plumage must become very much worn. Many male birds which require several years to attain their full adult plumage acquire some of the feathers characteristic of the adult plumage at this spring moult. The White-throated Sparrow, for instance, acquires additional white feathers on the throat and head, and yellow ones in front of the eye, and the Myrtle Warbler experiences an increase in the yellow feathers on the sides of the breast.

The second system of moulting consists of (1) a complete moult in the autumn or late summer and another moult in the spring, which is either complete or excludes the remiges and rectrices.

Such birds as the Scarlet Tanager, Indigo bird, etc., are examples of this class. Owing to the fact that many of them winter in the tropics it is difficult to obtain specimens showing the progress of the spring moult, and we are forced to a comparison of fall and spring birds. The Goldfinch, however, which can be obtained throughout the year in this latitude, shows the double moult very nicely, and specimens taken in April and September will be found respectively to be acquiring and losing the familiar bright yellow plumage, the gray feathers of winter appearing in the fall birds and disappearing in the spring ones.

The third system of moults seems the most complicated of the three, and was first pointed out by Mr. Frank M. Chapman in the case of the bobolink.

This bird has a complete moult in the late summer, then another complete moult in the early spring before it starts north from the tropics, and between that time and the breeding season an extensive abrasion, which again completely alters the appearance of the plumage. (See *The Auk*, 1890, p. 120.)

Specimens of the Rose-breasted Grosbeak which I have recently examined, taken in South America, seem to indicate that this species has a similar system of moulting to that of the Bobolink.

So far as I can ascertain, the adult male in fall assumes the striped brown dress of the female, but differs from it in having bright pink under wing-coverts and a marked pink suffusion on the breast. Opposed to this is the well-known black and white plumage of the breeding bird with its brilliant pink breast. Now the South American birds above alluded to are different from either of these. They possess the full plumage of the breeding bird, but every feather has a light brown or buff edging which gives the bird a "veiled" appearance and conceals to a certain extent the striking markings of the nuptial dress.

These specimens indicate pretty clearly that in addition to the annual fall moult the male Rose breast has a complete moult during the winter or early spring, assuming at this time a dress which differs decidedly from the breeding plumage, but which changes into it by means of extensive abrasion.

The lower orders of birds have as a general thing still more complicated moults than are found in the Passeres, and of most of them comparatively few of the details are known.

In consideration of these facts as well as the great interest that this study possesses, I cannot but recommend to all collectors to have this matter in view in making future additions to their collections and to look over the material which they already possess with an eye to the moult, feeling sure that they will be well repaid for their pains.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Comparative Longevity.

Among mammals the epoch of maturity is usually stated as reached in one-fifth of the animal's life. Thus the ages of maturity and periods of life of several forms are about as follows: horse, bull, four to twenty; sheep, two to ten; rabbit, one to five; but there are exceptions, such as the cat, which matures in one year and may live twenty.

It is assumed that man matures at twenty, and hence, by the rule, should live to be one hundred, as does the elephant, which matures in its twentieth year. But, I think that writers upon longevity, such as Hufeland, Flourens, Quatrefages, Thoms, etc., when commenting upon these relationships, have overlooked the fact that the general rule holds better for the lower races of men who mature sooner than the civilized, to whom the retardation of early development is an advantage, as it prolongs the plastic, receptive period.

The helplessness of the human infant at birth, and the length of time it needs parental care, in these respects differing from